RECEIVED
CENTRAL FAX CENTER
DEC 2 8 2004

Perkins Coie
1201 Third Avenue, Suite 4800
Seattle, WA 98101-3099
PHONE: 206.359.8000
FAX: 206.359.9000
www.perkinscoie.com

FACSIMILE COVER SHEET

CONFIDENTIAL AND PRIVILEGED

If there are any problems with this transmission, please call:

- ☒ Central Fax Room: 206 359-8575
- ☐ 505 Union: 206 287-3505
- ☐ Galland Reception: 206 359-8000
- ☐ *Sender's name and phone number
- ☐ Individual Floor:

DATE: *December 28, 2004* COVER SHEET & 13 PAGE(S)

CLIENT NUMBER: *38547-8006-US00*

RETURN TO: (NAME) *Lana Anthony* (EXT.) *3920* (ROOM NO.) *4111*

ORIGINAL DOCUMENT(S) WILL BE: ☐ SENT TO YOU ☒ HELD IN OUR FILES

SENDER:	TELEPHONE:	FACSIMILE:
Christopher J. Daley-Watson	(206) 359-3599	(206) 359-4599

RECIPIENT:	COMPANY:	TELEPHONE:	FACSIMILE:
Examiner Paul L. Kim	USPTO	(571) 272-2217	(703) 872-9306

RE: Application No. 10/805,066
Title: "SYSTEM AND METHOD FOR SAMPLE DETECTION BASED ON LOW-FREQUENCY SPECTRAL COMPONENTS"

Dear Examiner Kim:

Attached hereto is a Draft Response <u>that is not to be placed in the file permanently.</u> While we are scheduled for an interview with you and your supervisor on January 4, 2005 at 3:00 p.m., I'm sorry to say that we will need to reschedule because the inventor is unable to attend then.

My secretary, Lana Anthony, will be calling you shortly to set up an interview later in January.

Thank you.

Sincerely,
Christopher Daley-Watson

DRAFT

Express Mail No.

Attorney Docket No. 385478006US

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

IN RE APPLICATION OF:	BENNETT M. BUTTERS	EXAMINER:	KIM, PAUL L.
APPLICATION NO.:	10/805,066	ART UNIT:	2857
FILED:	MARCH 19, 2004	CONF. NO:	7922
FOR:	**SYSTEM AND METHOD FOR SAMPLE DETECTION BASED ON LOW-FREQUENCY SPECTRAL COMPONENTS**		

Amendment Under 37 C.F.R. § 1.111

M/S Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Commissioner:

The present communication responds to the Office Action dated September 23, 2004 in the above-identified application. Please amend the application as follows:

Amendments to the Specification begin on page __.

Amendments to the Drawings are reflected in an attached replacement sheet and are discussed on page ___.

Amendments to the Claims are reflected in the listing of claims beginning on page ____.

DRAFT

Express Mail No. Attorney Docket No. 385478006US

In the Specification:

[We will update the specification to fill in some blanks with missing application numbers]

DRAFT

Express Mail No. Attorney Docket No. 385478006US

In the Claims:

Following is a complete listing of the claims pending in the application, as amended:

1. (Currently Amended) Apparatus for use in detecting a selected material in a sample, comprising

(a) a sample holder for holding the sample, the holder being shielded from ambient electrical and magnetic energy,

(b) a noise generator for introducing noise into the sample, without ionizing the sample,

(c) a data storage device for storing, for each of one or more preselected materials including the selected material, a data set containing low-frequency spectral components that are (i) in a selected frequency range between DC to 50 kHz, and (ii) characteristic of that material,

(d~~b~~) a detector assembly including a detector coil adjacent the sample holder for producing ~~generating a~~ time-domain signal having signal components related to low-frequency electromagnetic radiation produced by the selected material in the sample, ~~when the sample is placed adjacent the coil,~~

(e~~c~~) signal conditioning components for converting the signal from the detector coil to an amplified conditioned signal from which frequency components above a selected frequency have been removed,

(f~~d~~) an electronic computer operably connected to ~~the~~the conditioning components to receive the conditioned signal therefrom, and for processing this signal by:

(i) retrieving from ~~the~~the data storage device ~~(a),~~ a data set of low-frequency spectral components characteristic of the selected sample material,

(ii) filtering the conditioned signal, with such in digitized form, to

DRAFT

selectively pass low-frequency spectral components corresponding to those of the retrieved data set;

(iii) cross-correlating the filtered signal from (ii) with the data set of low-frequency spectral components from (i) to produce a frequency-domain spectrum in a frequency range within DC to 50 ~~K~~kHz, and

(iv) determining whether the frequency-domain spectrum contains one or more low-frequency signal components that are characteristic of the selected material, and diagnostic of the presence or absence of such material in the sample, and

(ge) an interface device operably connected to the computer for displaying the output of the processing.

2. (Original) The apparatus of claim 1, for use in detecting a material in a fluid sample, wherein the assembly includes a sample tube having sample inlet and outlet ports through which sample can be directed through the tube, and the detector coil is wound about the tube in a winding direction substantially perpendicular to the direction of sample flow in the tube.

3. (Original) The apparatus of claim 2, wherein the tube is formed of pyrex glass.

4. (Original) The apparatus of claim 2, wherein the detector assembly further includes a toroidal ferrite core having the collector tube disposed about at least a portion of the circumference of the core, and the detector coil is wound around the tube and core in a radial winding direction.

5. (Original) The apparatus of claim 4, wherein the detector assembly further includes a source of Gaussian noise and a noise-injection coil wound about the circumference of the toroidal core, through which Gaussian noise can be introduced

DRAFT

from the source into the sample in the tube.

6. (Original) The apparatus of claim 1, wherein the detector coil includes a Helmholz coil having a pair of opposed coil elements between which the sample can be placed.

7. (Original) The apparatus of claim 6, wherein the opposed coil elements define an open sample-detection region therebetween, through which self-supporting samples can be inserted and removed.

8. (Original) The apparatus of claim 1, wherein the detection coil includes a Tesla coil.

9. (Original) The apparatus of claim 1, for use in detecting gaseous or particulate material in a gaseous-stream sample, wherein the assembly includes a collector filter effective to trap such material, as the sample passes through the filter, and the a detector coil placed against the filter and having a winding direction substantially parallel to the filter.

10. (Original) The apparatus of claim 1, wherein the computer is operable, in carrying out (iv), of identifying the frequencies of low-frequency signal-components in the spectrum whose cross-spectral correlations have a selected statistical measure above background spectral noise.

11. (Original) The apparatus of claim 1, wherein the computer is operable, in carrying out (iv), of (iva) receiving an additional frequency-domain spectrum for a given sample, (ivb) adding the additional spectrum to the originally produced spectrum, and averaging the added spectra, and (ivc) repeating (iva) and (ivb) until components in the summed and averaged spectrum have a selected statistical measure above

DRAFT

background noise.

12. (Currently Amended) A method for detecting a selected material in a sample, comprising:

(a) placing the sample adjacent a detector coil,

(b) while introducing noise into the sample, and without ionizing the sample, detecting ~~thereby to generate~~ an electromagnetic time-domain signal produced in the detector coil by the sample, ~~composed of sample source radiation,~~

(c~~b~~) conditioning the time-domain signal to convert the signal to an amplified conditioned signal from which frequency components above a selected frequency have been removed,

(d~~c~~) filtering the conditioned time-domain signal to selectively pass low-frequency spectral components that are (i) in a frequency range between DC and 50~~K~~ kHz, and (ii) characteristic of the selected material,

(e~~d~~) cross-correlating the filtered signal from (c) with a data set of low-frequency spectral components that are (i) in a frequency range between DC and 50 kHz, and (ii) characteristic of a selected material, to produce a frequency-domain spectrum in the frequency range within DC to 50 ~~K~~kHz, and

(f~~e~~) determining whether the frequency-domain spectrum contains one or more low-frequency signal components that are characteristic of the selected material, and diagnostic of the presence or absence of such material in the sample.

13. (Original) The method of claim 12, for use in detecting a material in a fluid sample, wherein the placing includes flowing the sample through a sample tube having sample inlet and outlet ports, and the detector coil is wound about the tube in a

DRAFT

winding direction substantially perpendicular to the direction of sample flow in the tube.

14. (Original) The method of claim 13, wherein the sample tube is disposed adjacent a toroidal ferrite core, the detector coil is wound around the tube and core in a radial winding direction, and which further includes injecting Gaussian noise into the sample during generation of the time-domain signal.

15. (Original) The method of claim 12, wherein the detector coil includes a Helmholz coil having a pair of opposed coil elements, and the placing includes placing the sample between the coil elements.

16. (Original) The method of claim 12, for use in detecting gaseous or particulate material in a gaseous-stream sample, wherein the placing includes passing the sample through a planar filter effective to trap such material, as the sample passes through the filter, and the detector coil has a winding direction substantially parallel to the plane of the filter.

17. (Original) The method of claim 12, wherein the determining includes identifying the frequencies of low-frequency signal components in the spectrum whose cross-spectral correlations have a selected statistical measure above background spectral noise.

18. (Original) The method of claim 12, wherein the determining includes (a) receiving an additional frequency-domain spectrum for a given sample, (b) adding the additional spectrum to the originally produced spectrum, and averaging the added spectra, and (c) repeating (a) and (b) until components in the summed and averaged spectrum have a selected statistical measure above background noise.

19. (Currently Amended) A system for detecting a selected material in a

DRAFT

sample, comprising:

means for holding ~~placing~~ the sample adjacent a detector coil, thereby to generate an electromagnetic time-domain signal composed of sample source radiation, without gas chromatography or ion cyclotron resonance,

means for introducing noise into the sample during the signal generation,

means for conditioning the time-domain signal to convert the signal to an amplified conditioned signal from which frequency components above a selected frequency have been removed,

means for filtering the conditioned time-domain signal to selectively pass low-frequency spectral components that are (i) in a frequency range between DC and 50 kHz, and (ii) characteristic of the selected material,

means for cross-correlating the filtered signal with a data set of low-frequency spectral components that are (i) in a frequency range between DC and 50 kHz, and (ii) characteristic of a selected material, to produce a frequency-domain spectrum in the frequency range within DC to 50~~K~~ kHz, and

means for determining whether the frequency-domain spectrum contains one or more low-frequency signal components that are characteristic of the selected material, and diagnostic of the presence or absence of such material in the sample.

20. (Original) The system of claim 19, further comprising means for automatically extracting the sample from an environment surrounding the system, and wherein the sample is air or gas.

21. (Original) The system of claim 19 wherein the means for placing includes toroidal detector means for detecting an electromagnetic signal from the sample.

DRAFT

Express Mail No. Attorney Docket No. 385478006US

REMARKS

Reconsideration and withdrawal of the rejections set forth in the Office Action dated September 23, 2004 are respectfully requested.

I. Amendments

In response to the objection to claim 1, duplicate occurrences of the word "the," have been deleted to overcome this objection. Claims 12 and 19 have been amended to clarify an aspect of the invention as revised in these claims. Several typographical errors were also corrected.

II. Rejections under 35 U.S.C. § 103

A. The Applied Art

Claims 1, 6-9, 12, 16, and 19-21 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Wells.

Claims 2-4, 13, and 15 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Wells in view of Barnes.

Claims 10, 11, 17, and 18 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Wells in view of Gethner et al.

Wells is directed to a method of speeding up analysis of components in gas chromatography (GC). Under Wells, a gas is provided to a column 14, which separates components as the gas travels through the column. The output of the column is provided to a ion cyclotron resonance (ICR) cell 20. An ionizing beam of electrons is injected into the cell, and the ions formed depend on substances in the cell, namely gases from the column 14. A voltage pulse having properties such that it contains all frequencies required to excite ions in the cell is provided to opposing cell plates. The ions in the cell absorb radio frequency (RF) power from the pulse and induce current signals, which the cell outputs to an amplifier 30. An amplified signal output from the amplifier is then filtered, converted to digital form, and input to a computer. Under Wells, the computer can avoid Fourier transform (FT) computations, but instead

DRAFT

operate on the digitized signal in only the time domain (as opposed to the frequency domain using FT).

In contrast, the applicant's technology is directed to a system for detecting a selected material in a sample by detecting very low amplitude electromagnetic signals produced by the sample itself via a detector coil placed next to the sample, when noise is introduced into the sample as effectively the sole source of external energy. Through Stochastic resonance, the low amplitude signals may be detected. In general, all matter capable of certain modes of molecular motion produces very low level electromagnetic emissions that may be detected by the system described in the application. In particular, electromagnetic signals emitted from the sample are stored as a time domain signal. This signal is then converted, such as digitized, and input to a computer for further signal conditioning. The computer "cross-correlates" the signal with stored data signals to produce a frequency-domain spectrum. The computer may then determine whether the frequency-domain spectrum contains signal components characteristic of a selected material.

The cross-correlation may be performed by a microprocessor, digital signal processor (DSP) or monolithic processor chip, programmed to perform Fourier correlative analysis of the detected signal as compared to Fourier data of a stored and known signal. See, e.g., Application, p. 11. In other words, the system obtains a time-domain signal, and then compares a frequency domain representation of that signal with stored frequency-domain signals to identify whether a sample contains a selected material.

B. Analysis

As noted above, Wells operates on a time-domain signal, rather than operating in the frequency domain. Wells performs no "cross-correlating" to "produce a frequency-domain spectrum" from a signal produced from a sample. For example, column 6, lines 42-53 of Wells note that the correlation or comparison of signals is done in the time domain. The Office Action cites to column 7, lines 1-5 of Wells, but

DRAFT

Express Mail No. Attorney Docket No. 385478006US

this portion of Wells describes comparing time-domain signals, not frequency-domain signals as in the claimed invention.

Possibly more importantly, Wells teaches away from analyzing signals in the frequency domain. For example, column 2, lines 57-62 explain that "by directly comparing the time domain signal output from the sample cell with time domain data from a known standard, one can . . . forego FT analysis." (As is known, Fourier transformation (FT) converts a time domain signal to a frequency domain signal.) Other references to avoiding FT or frequency domain analysis are found in Wells (see, e.g., Abstract; column 6, lines 20-23).

Another important distinction between Wells and the applicant's technology is that Wells employs ion cyclotron resonance (IRC) gas chromatography (GC). Under the IRC form of GC, a sample is vaporized or turned into a gas, and that gas is then ionized. Applicant's technology, instead, avoids such expensive and destructive techniques, and instead can pick up low-level electromagnetic signals or radiation from a sample. In particular, the claimed invention employs a detector assembly that includes a "detector coil for generating a time-domain signal," where the sample is "placed adjacent the coil." While the Office Action identifies parts 10 of Figure 2 in Wells as a "detector coil," this part is instead a GC column (see, e.g., column 6, lines 32-35). Such a column is not a detector coil. Possibly more importantly, the column of Wells requires the gas to travel through the column; the claimed invention requires the sample only be placed adjacent the coil.

Additional differences exist between Wells and the claimed invention. For example, the claimed invention employs both signal conditioning components that remove selected frequency components, as well as an electronic computer that performs filtering to selectively pass low-frequency spectral components. Wells employs only a single filter 32 for processing the sample signal.

Furthermore, the claimed system generates signals from a sample thorough Stochastic resonance, by introducing noise into the sample region. This method of

DRAFT

analyzing a sample can be non-destructive, as opposed to gas chromatography under Wells, which requires ionizing or vaporizing the sample.

The remaining independent claims 12 and 19 recite similar limitations. For example, claim 12 recites a detector coil that generates an electromagnetic time-domain signal composed of sample source radiation. Likewise, claim 19 recites means for placing the sample adjacent a detector coil to generate an electromagnetic time-domain signal composed of sample source radiation. Further, these claims recite introducing noise into the sample during signal generation.

Claim 12 recites two filtering steps, including conditioning the time-domain signal whereby frequency components above a selected frequency have been removed, as well as filtering the conditioned time-domain signal to selectively pass low-frequency spectral components. Claim 19 recites similar means for performing these functions. Further, claim 12 recites cross-correlating the filtered signal with a data set of "low-frequency spectral components" (i.e., frequency domain signals), while claim 19 recites means for similarly cross-correlating the filtered signal. As noted above, cross-correlation corresponds to conversion and analysis of signals in the frequency domain; Wells not only performs all analysis in the time-domain, but also teaches away from analysis in the frequency domain.

To further distinguish from Wells, claim 12, as amended, now recite *inter alia* introducing noise into the sample, without ionizing the sample, to detect an electromagnetic time-domain signal that the sample remains substantially stationary and is non-ionized. As explained in Wells, mixtures of chemical compounds are separated as they travel through the column in gas chromatography (column 1, lines 14-19), and an electron beam ionizes the sample in the cell in ion cyclotron resonance (column 3, lines 24-27). Claim 19 now recites that the means for placing the sample adjacent a detector coil to generate an electromagnetic time-domain signal is done without gas chromatography or ion cyclotron resonance. The claimed invention avoids drawbacks of gas chromatography and ion cyclotron resonance.

DRAFT

Express Mail No.

Attorney Docket No. 385478006US

III. Conclusion

Overall, none of the applied references, singly or in any motivated combination, teach or suggest the features recited in independent claims 1, 12 and 19, and thus such claims are allowable. Since these independent claims are allowable, based on at least the above reasons, the claims which depend from them are likewise allowable. If the undersigned attorney has overlooked a relevant teaching in any of the references, the Examiner is requested to point out specifically where such teaching may be found.

In view of the foregoing, the claims pending in the application comply with the requirements of 35 U.S.C. § 112 and patentably define over the applied art. A Notice of Allowance is, therefore, respectfully requested. If the Examiner has any questions or believes a telephone conference would expedite prosecution of this application, the Examiner is encouraged to call the undersigned at (206) 359-3599.

Respectfully submitted,
Perkins Coie LLP

Date:____________________

Christopher J. Daley-Watson
Registration No. 34,807

Correspondence Address:
Customer No. 25096
Perkins Coie LLP
P.O. Box 1247
Seattle, Washington 98111-1247
(206) 359-8000